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Article (Accepted Version)

This is a pre-copyedited, author-produced version of an article accepted for publication in Science and Public Policy following peer review. The version of record is available online at: https://doi.org/10.1093/scipol/scx073

Towards evidence-based industrial research and innovation policy

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Published in *Science and Public Policy*, 45 (2018), 143-150

Abstract

Calls for better use of scientific evidence to inform policy decisions stem from the belief that enhanced outcomes for the society can be expected. Yet the introduction of evidence-based practices in innovation policy making has not come without criticism. This introductory article sets the scene for the short collection of papers that address specific issues regarding the prospect of better evidence-based policy in the area of industrial research and innovation (IRI). It identifies and discusses key challenges for the transition towards evidence-based industrial research and innovation policy. It then introduces the three papers, which build upon and depart from related assumptions or narratives reflecting the current state of practices in IRI policy.

I. Introduction

The transition from an essentially opinion-based approach to a more rigorous and evidence-based approach to policy decision-making has increased the demand for better integration of evidence-based practices into the formulation and implementation of government policies. Evidence-based policy (EBP) and practice means integrating experience, expertise and judgement with the best available external evidence from systematic research (Sackett et al., 1996; see also Davies, 1999, and his definition of 'evidence-based education'). A principal rationale lies in the belief that enhancing the knowledge base for policy making and practice is likely to lead to better outcomes[3]. Bringing evidence to bear on policy and practice raises at

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[3] See for instance the healthcare (http://www.cochrane.org) and socio-economic domains (http://www.campbellcollaboration.org/).

least two fundamental issues, however. The first concerns the type of evidence[4] required to address policy needs, while the second refers to a set of challenges at the science-policy interface, in particular the question of how best to convey evidence to policy practitioners and practice. The transition towards evidence-based policy has also been related to the need for a sound basis for better regulation (European Commission, 2015; ESPAS, 2015) and for better integration of scientific and academic thinking and insights into the formulation, implementation and evaluation of policy.

Within the domain of industrial research and innovation (IRI) policy, the use of scientific evidence to inform policy relates mainly to the belief that innovation is a key driver for a sustainable economic development with high social returns, and to the fact that interpreting evidence on R&D and innovation is not straightforward, precisely because of the specific, contextual and uncertain nature of the processes and outcomes of research and other innovative activities. Hence, the overarching rationale is that the design of sound and more comprehensive theoretical and empirical frameworks is essential in order to apprehend the systemic and complex aspects of R&D and innovation. Moreover, the availability of adequate data on, and conceptual approaches to, the dynamics of innovation are of primary importance for the design, implementation and evaluation of related policies. However, the indicators and conceptual frameworks commonly used thus far still exhibit many limitations, which are likely to lead to or at least encourage short-sighted innovation and industrial policies, or to policies doomed to be confined to boundaries set by the prevailing techno-economic paradigm. In particular, they often fail to reflect the non-linearity of fast-evolving global and local innovation and of corporate dynamics (Esperanza and Dirk, 2014; Mazzucato et al., 2015; Veugelers and Schweiger, 2016).

Building upon this background and the outcomes[5] of the Conference on Corporate R&D and Innovation, this short collection of papers addresses the role of scientific analysis in the design and implementation of EU industrial policies relating to research, innovation and technological advancement. The Special Issue raises questions related to the extent to which the available evidence satisfactorily supports policy actions for corporate R&D and innovation. Adopting various complementary perspectives, the selected studies contribute to the prospects for evidence-based R&D and innovation policy. They reappraise fundamental rationales about the dynamics of knowledge and innovation and offer, in a complementary manner, relevant conceptual and empirical insights for arriving at better-informed industrial research and innovation policy. More specifically, they challenge certain underlying assumptions and expectations about current R&D and innovation policy conceptual frameworks and

[4] Evidence may refer to 'the available body of facts or information indicating whether a belief or proposition is true or valid' (Oxford dictionaries). Although not addressed in this introductory background note, several works have discussed the intrinsic limits of "evidence", its production and dissemination patterns and the conditions under which evidence could be better used to inform policy and practice in healthcare and social domains (see e.g. Guyatt et al., 1992; Sackett et al., 1996; Nutley et al., 2003; Mulgan, 2005; Pawson et al., 2011; Cartwright and Hardie, 2012).

[5] The CONCORDi 2015 conference offered a platform to discuss the role of scientific analyses in the design and implementation of an EU industrial policy based on research, innovation and technological advancement. For the CONCORDi 2015 background note and policy report, see Dosso *et al*. (2015a & 2015b).

programmes. With this aim, the papers rely to differing degrees on new theoretical models as well as on an empirical (re)assessment of the evidence relevant to achieving better policy making and practice in the area of industrial research and innovation.

The remainder of the article identifies and discusses key challenges for the prospects of better EBP making in the area of IRI (Section 2). Section 3 presents the analytical focus of the three papers, building upon the main challenges identified by the authors in relation to the use of evidence to inform IRI policy. Section 4 summarizes and suggests a number of issues regarding evidence-informed policy that deserve further research.

II. Towards better evidence-based industrial research and innovation (IRI) policy: Implications from innovation studies and key challenges for evidence-based practice

Policy expectations with regard to innovation in terms of growth, employment and solutions to global challenges are high. On the other hand, limited budgets and fiscal consolidation mean that public expenditures on research and innovation have barely expanded, so that generating higher returns from public spending on research and innovation becomes ever more crucial. Hence, the development of case studies or metrics to assess the impact of policy instruments, in particular those aimed at stimulating private R&D spending. Research on industrial research and innovation (IRI) has flourished over the last two decades and has yielded important improvements in our understanding of innovation, its effects and its determinants. This evolution has been important both for broadening our scientific knowledge and for enabling better (i.e. more advanced and more useful) information to be provided to policy-makers. While this introductory article does not attempt to review that evolution, there are grounds for assuming that it has to some extent influenced industrial research and innovation policy.

Hence, instead of offering a detailed discussion of the link between innovation studies (see Martin, 2012) and policies, we begin by adopting a rather narrower approach. This builds upon the key challenges for (future) innovation studies, which have been identified in a more extensive manner by previous studies (e.g. MIoIR, 2013; Love and Roper, 2015; Martin, 2016a & 2016b).

In Table 1 we attempt to identify possible links between key challenges for innovation studies and the broad implications for policies supporting industrial research and innovation. In doing so, we are able to illustrate in an intuitive and straightforward manner how policy makers may think about and integrate specific (pieces or dimensions of) evidence on IRI in their practice.

Table 1. Key challenges for innovation studies and examples of corresponding IRI policy issues / implications

Key challenges for innovation studies	Examples of policy issues/ implications
Measurement and analytical bias towards dominant forms of innovation (e.g. manufacturing, high-tech sectors) Innovations rely on different processes, actors and knowledge sources	*Which type of innovation (impact) is actually supported by the policy intervention? Which kind of innovation is to be supported or is seen as desirable?*
(Expected) impacts of innovation are broad (growth, productivity, reduction of inequality, environmental sustainability, etc.)	*Innovation a means towards an end* *Which innovation or directions for innovation are to be supported to reach identified objectives and goals?*
Analysis of global innovation systems and their interactions with national or regional innovation systems	*Design of policy support for the integration of local firms into international networks, while ensuring beneficial local effects in terms of growth, employment, etc.*
Role of public support or government intervention	*The policy problems should be clearly identified, formulated and communicated*
Study/identify the balance between IP protection and open innovation, and between cooperation and competition	*Fine-tune/balance support and regulation for innovation and related policy areas*
Academic bubbles, disciplinary sclerosis	*Development of conceptual frameworks for changing or new policy challenges or priorities*
Firms' heterogeneity with regard to R&I (also heterogeneous) within industrial sectors	*Policies that are able to take account of both industrial sectors' and firms' specificities*
The impact of different eco-system components on SME innovation and exporting	*Coordinated policy support, with close alignment between policy on both areas*

Source: Authors' elaborations, column 1 adapted from MIoIR (2013), Love and Roper (2015) and Martin (2016a & 2016b).

Deriving policy implications from the analytical challenges of innovation studies allows in a rather generic fashion to shed light on specific and concrete issues that should be addressed in the design and implementation of IRI policies. However, such an approach remains limited when it comes to apprehending the broader and more fundamental issues at the science and policy interface (i.e. when policy actually uses or attempts to use evidence on IRI to design supportive programs).

Accordingly, the next part of this section adopts a complementary and more comprehensive approach, which should allow the reader to better understand the wide range of possible challenges to achieving better evidence-based IRI policy and practice – i.e. integrating

experience, expertise and judgement with the best available external evidence from systematic research[6].

The calls for practicing more and better evidence-based policy have a particular resonance in the R&D and innovation policy context. The introduction of evidence-based practices into innovation policy thinking and making has not come without criticism. The first set of critical issues relates to the limitations imposed by certain prevailing theoretical and conceptual frameworks used for policy intervention in the area of industrial research and innovation. A second set of issues relates to the lack of appropriate contextual evidence for the design and implementation of national and regional industrial research and innovation policies, a problem that can lead to misuse of the available evidence. A third issue is how well-equipped the academic community is to address the industrial and innovation policy challenges, in particular the still unfolding micro-macro interactive dynamics of innovation. In addition, there are issues raised with regard to the operationalization of, and the conditions for, successfully translating evidence on corporate R&D and innovation into meaningful and successful policies actions.[7] These three sets of issue are briefly discussed in the following paragraphs.

a. Limitations of theoretical/conceptual frameworks to inform IRI policy

A key policy rationale for supporting industrial research and innovation (IRI) lies in the so-called 'undersupply' argument. According to this, firms will be reluctant to invest in a situation of uncertainty (e.g. with regard to time horizon; investment scale; impossibility of assessing the probable distribution of expected returns - Arrow, 1962; Antonelli, 2009, Amoroso et al., 2016). This rationale still has important implications for the conceptual frameworks used to explain and monitor corporate research and innovation activities (Aghion, 2009; Mazzucato et al., 2015). Indeed, R&D-based measures constitute fundamental indicators for assessing corporate innovation investments, both for international comparison purposes as well as providing policy targets at both the territorial and industrial levels.

The limitations of such an approach have been underlined by earlier studies. In this respect, a number of important caveats are worth restating: *(i)* R&D patterns and impacts depend on the industry context (Mathieu and van Pottelsberghe de la Potterie, 2010; Moncada-Paternò-Castello *et al*., 2010; Moncada-Paternò-Castello, 2016); *(ii)* R&D indicators do not tell us much about how the knowledge or information generated in the process is actually translated into concrete outputs, which may lead to an overestimation of unproductive R&D investments; while the relationships between R&D and intangibles such as valuable patents on the market is well documented (Arora et al., 2008), more analysis and evidence are needed in order to understand the conditions under which R&D activities lead to innovation (e.g. new products, processes, marketing and organisational methods, etc.) and, ultimately, to socio-economic benefits; and *(iii)* R&D measures at the territorial level remains limited, especially when it

[6] See references in the introductory section.
[7] See also the policy brief and background note issued in the frame of CONCORDi 2015 (Dosso et al., 2015a & 2015b).

comes to assessing the contribution of R&D from large MNEs (Bjørnskov and Foss, 2016) and their impact on the innovation capabilities and economic performance of local firms. Acknowledging these limits, observable efforts have been devoted to broadening the measurement of innovation. *Non-R&D innovation* data are increasingly used (e.g. European Innovation Scoreboards, and the OECD Science, Technology and Industry Scoreboard)[8], being collected for instance through innovation surveys (e.g. Community Innovation Surveys, CIS).

The support for industrial innovation also stems from the belief that innovation is the main answer to the growth, employment and competitiveness 'shortages' faced by many countries and regions, particularly in mature economies. Yet the links between innovation and growth are not straightforward and they can be asymmetric (Geroski and Mazzucato, 2002; Audretsch et al., 2014). For instance, the widely accepted labour-friendly effects of innovation are far from being systematic, not least as other opposing forces might be at play depending on the type of innovation and the industry (Harrison et al., 2014; Vivarelli, 2014).

Moreover, the need for firms to be profitable may not align with the wishes of larger and more innovative firms. Focusing on high growth may be more destructive for the profitability of certain types of start-up firms, especially those with a low-profit rate or very young entrants. In other words, more growth is not necessarily what is generally sought by entrepreneurs. Growth may not always be good and is often quite problematic and barely sustainable (Brännback et al., 2014, Coad et al., 2014).

b. The (risk of) misuse of available evidence on IRI

The problems of evidence availability for IRI policy or evidence intended to help in addressing a particular policy problem[9] can be at least threefold. A first concern is the strict absence of evidence on IRI or when no scientific evidence is available on the topic or relationships to be investigated (e.g. the impact of R&D policy instruments on firm performance, finance and innovation[10]). In these cases, it is reasonable to assume that individual motives, faith, opinion and experience (or practice-based knowledge), and expert judgement may each guide the policy design and choice of policy instruments for innovation. On related aspects, Correa and Guceri (2016) discuss in particular how the problem of information failure may limit the feasibility and reliability of innovation policy, focussing on recent European experiences with regional 'smart specialisation' strategies.

A second aspect resides in the lack of context-specific evidence (e.g. for a particular country, region, and industry): evidence on the topic and relations may exist but it has generally been produced for different purposes or different social, spatial and cultural contexts. A key challenge is thus to know under which conditions evidence about the impact of R&D subsidies in a given country, region and/or industry *A* can be relevant or suitable to the context *B*, even

[8] See respectively at http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_fr and http://www.oecd.org/sti/scoreboard.htm (accessed on 6 July 2017).
[9] See Edquist (2011) for a specific discussion of innovation policy problems.
[10] See reviews on these issues respectively in Martin (2016b) and Hall et al. (2016).

if similar industrial sectors are targeted. Moreover, when both geography- and industry-specific features (conditions) are taken into account, the transferability of the analytical findings is even more constrained.

In both cases, the risk of mimicking behaviour is likely to increase, as evidence is somehow blind to industrial and territorial differences or to other specific features. This practice is often referred to as adopting a "one-size-fits-all" policy approach (Tödtling and Trippl, 2005), in other words, adopting policies that are not tailored to the target individuals, geographic areas, industries or firm types. This approach has certainly contributed to the references to R&D as a transversal or horizontal policy option. In a similar vein, several governments have already begun implementing favourable tax treatment for R&D and patenting activities (e.g. R&D tax credits, patents subsidies and patent boxes) in order to foster and attract knowledge-intensive activities to their territories. However, as suggested by Alstadsæter et al. (2016), attracting patent filings does not necessarily imply anything about the actual performance of the R&D and innovation activities for which patent protection is being sought.

The question of how to use scientific evidence cannot be readily separated from a consideration of the transmission channels for evidence about innovation to policy. A related concern resides in the fact that evidence is often scattered across various sources or studies, and often is not synthesized for the purposes of policy. Nevertheless, systematic reviews and meta-analyses are increasingly used, though still quite rare in the realm of economics of innovation[11]. Elsewhere, well-known dedicated communities and initiatives such as the Cochrane and Campbell Collaborations [12] aim at collecting and thereby offering access to the best possible evidence, targeting healthcare decisions and social and educational interventions, respectively.

c. How well-equipped is the academic community to address IRI policy challenges?

Last but not least is the scope of data and methodological toolboxes available for the scientific community to inform policy making. Of particular interest in the context of the CONCORDi 2015 conference is the lack of appropriate data to describe IRI activities, especially for firms with international innovation activities – i.e. those that carry out the bulk of the business sector R&D (EU Industrial R&D Investment Scoreboard[13]). The main concern also holds true for small firms with limited reporting capabilities. A second issue relates to the call for more and better evaluations or impact studies at different stages of the policy cycle (EC, 2013; OECD, 2010). Evaluations should inform policy makers not only on what works but also on what does not work and the conditions under which interventions do or do not work. Important considerations that were underlined at the conference also illustrate the methodological challenges of impact studies, in particular the issue of the additionality of public support to

[11] See for instance the Compendium of Evidence on Innovation Policy (MIoIR, 2013). See also the book by Stanley and Doucouliagos (2012), which provides a summary of the state of the art on the tools of meta-analysis and meta-regression analysis for Economics and Business.
[12] http://www.campbellcollaboration.org/ (accessed on 6 July 2017).
[13] http://iri.jrc.ec.europa.eu/home (accessed on 6 July 2017).

innovation. Additionality may refer to the real net increase (compared to a counterfactual situation of no intervention) in firms' innovation investments, to outputs and outcomes, or to changes in firms' learning and interactions, following the receipt of public support for R&D and innovation. As underlined by Georghiou (2002) and Söderblom et al. (2015), identifying the appropriate methodology to assess the relevant counterfactual is a major concern for the additionality literature. The exercise is even more difficult when attempts are made to account for the interactions between industrial innovation policies and their effects, and other areas of policy regulation and intervention (labour markets, environment, education, competition, etc.) and their effects.

Beyond the impacts of policy in terms of IRI activities (a first order effect), the second or higher order effects can diverge from policy expectations or targets; for instance, the effects on growth and employment that might derive from the supported innovation activities. The question is thus to know under which specific conditions an IRI policy instrument triggering additional innovation investments may also lead to growth and employment.

III. The analytical focus of the collection of papers

Acknowledging the limitations of previous work in the field of evidence-based industrial R&D and innovation policy, the studies presented in the Special Issue raise questions about the evidence (or lack of it) for current policy thinking and for policies targeting primarily corporate R&D and innovation. More specifically, they challenge some key underlying assumptions (e.g. knowledge undersupply, the so-called 'European paradox') and expectations about current conceptual R&D and innovation policy frameworks and programmes. With this aim, the papers rely to a varying degree on new theoretical models as well as an empirical (re)assessment of evidence relevant to achieving better policy making and practice in the area of industrial research and innovation.

Consistent with the conceptual approach developed in the previous sections, each of the following three papers builds upon and departs from a specific assumption or narrative reflecting the current state of practices in industrial research and innovation (IRI). Rather than offering final answers, the articles pave the way for further reflection on the prospects of better evidence-based IRI policy. In what follows, the articles are introduced with the aid of a common format in order to allow the reader to better frame the analyses in terms of the broader challenges discussed in the previous section. First, the traditional assumptions challenged and the methodological frameworks are introduced. Second, the main findings questioning the current state of the art are highlighted. Finally, their main policy implications with respect to a better EBP in relation to their analytical focus are identified.

The paper by **Antonelli** on ***'Knowledge properties and economic policy: a new look'*** questions the scope of the application of the Arrovian postulate according to which the limited

appropriability of knowledge, due to its uncontrolled dissemination, reduces the incentive to generate knowledge and leads to an undersupply of knowledge (Arrow 1962). This knowledge 'market failure' has for long constituted the basis for the policy support to knowledge generation, for example through subsidies or the creation of large public research systems. However, and this is the starting point of the paper, this approach does not account for the full range of the effects of knowledge properties – transient appropriability, non-exhaustibility and indivisibility – and consequently may lead to the overestimation of the undersupply of knowledge. Combining the Arrow problem of weak intellectual property protection with the Griliches 'cure' of knowledge spillovers, the analysis puts forward a new 'two faces of innovation' insight, which requires lags in imitation, for which there is evidence. As an aside, the paper focuses on the private sector, as that is assisted by public knowledge-producing institutions, and public institutions partly provide the cure, the second face of innovation, through open dissemination of knowledge. The paper thus enriches the discussion of public policy regarding R&D support in the presence of externalities. The main novelty resides in considering the two opposing forces in a single analytical framework in order to better understand the full range of the effects of knowledge properties.

Building upon advances in the economics of knowledge, the paper proposes a graphic analysis of the market for knowledge, further implemented by a simple Schumpeterian (quality ladders) model allowing the full set of effects of the Arrovian properties of knowledge to be examined. The paper goes further by discussing the effects of different timing of the leakage and access to external knowledge. In so doing, it distinguishes circumstances under which the Arrovian postulate would apply from contexts where it does not – i.e. due to the positive effects of knowledge externalities, the costs of knowledge may be reduced and further supply of knowledge may take place, possibly overcoming the negative effects resulting from the limited appropriability of knowledge. According to the author, this effect would depend, amongst other things, on the quality of the knowledge governance – *the set of rules, procedures, modes and protocols that organize the generation, dissemination and use of knowledge in an economic system as a collective process* – (Antonelli, this Special Issue), and the connectivity of the knowledge production and dissemination system that affect the absorption costs of knowledge. These findings suggest at least two straightforward policy implications: *(i)* public intervention may not be needed if the supply of knowledge is larger than in situations of quasi-perfect appropriability; and *(ii)* public intervention is needed when the costs of access to knowledge are so high that they cannot compensate for the short time-window for appropriation.

The second paper by **Koen and Sachwald** on '***The dual impact of 'excellent' research on science and innovation: the case of Europe'*** tackles the implications of the policy emphasis on 'the European paradox' – in other words, *Europe is good at producing science but lags behind in translating the results of its research into marketable innovations* (EU 1995; 2003 quoted by Koen and Sachwald, this Special Issue) – and on the R&D gap with the US. These two arguments remain fundamental in the European innovation narrative. This narrative still provides the basis for many European policies supporting business R&D spending and research-to-market. Although alternative narratives of the transatlantic gap have been

proposed[14], an overall reappraisal of the causes of the European innovation deficit is missing. Bringing together evidence for such an updated appraisal constitutes the main purpose and contribution of the study.

The paper draws upon an extensive literature review on empirical studies of the interactions between excellent research and innovation-based microeconomic data, and a bibliometric analysis of the research performance of European countries. The quantitative analysis relies on the "Analysis and Regular Update of Bibliometric Indicators" carried out by ScienceMetrix for the Directorate General Research and Innovation of the European Commission (Campbell et al. 2013) and the National Science Board's Science and Engineering Indicators (National Science Board 2016). The data allow designing size-dependent and size-independent indicators of scientific impact in order to compare both the EU with other regions, and also European countries among themselves. The literature review highlights the role of excellent research or high impact publications (Koen and Sachwald, this Special Issue), even when it involves basic research, for attracting companies as well as the strong scientific and potential economic impact through innovation performance in high-technology sectors, for instance. Offering a new perspective on existing data, the paper argues that excellent research may indeed yield a dual impact on both science and innovation.

A main policy implication is that comprehensive IRI policies should account for the performance of countries in excellent basic and fundamental research, as they impact on the absorptive capabilities of European innovations systems. More precisely, new policies or strategic orientations in favour of applied and mission-oriented research should not endanger the funding of excellent research. Moreover, the authors suggest further research should be undertaken for the purpose of better evidence-based innovation policies. They mainly focus on the improvement of innovation measurement with a greater use of multidimensional indicators and better account being taken of the role of differentiated economic and industrial structures on R&D performance. This latter implication of the study resonates with prior analyses exploring the causes of sectoral or aggregate R&D intensity[15]. Furthermore, the paper suggests that qualitative impact studies of the scientific knowledge produced should be undertaken without weakening the incentives towards scientific excellence.

The third paper by **Duch-Brown, de Panizza and Rohman Kholilul** on ***'Innovation and Productivity in a Science-and-Technology Intensive Sector: Information Industries in Spain'*** contributes to the flourishing literature on industry-specific patterns of innovation, and their determinants and effects. More precisely, it brings together evidence on how innovation and innovation modes act as catalysts between R&D activities and productivity in the case of ICT firms, an issue for which evidence has so far been largely missing (Duch-Brown et al, this Special Issue). The paper argues that a common innovation definition (encompassing product, process, organizational and marketing innovations) is not suitable for representing the multidimensional modes of innovation in the ICT sector. Indeed, the cycles of innovation and obsolescence often appear faster than in the majority of other industries. Relying on a broader

[14] See for instance Pavitt (2000), quoted by the authors.
[15] See for instance the references in *Section II, a.*

definition of the ICT industries, extending to the content and media (CM) industries, the paper develops a more comprehensive picture of existing strategic links related to innovation in this sector. It argues that such a perspective could allow a better characterization of the challenges faced by the ICT sector in Europe. As a second step, the authors discuss key factors, obstacles and effects of ICT firms' R&D and innovation decisions.

The study of the drivers and barriers and the contribution of different types of innovation to productivity are based on a sample of Spanish ICT firms included in the Spanish Technological Innovation Panel (PITEC database), the source for the Community Innovation Survey, for the period 2004-2013. The econometric application relies on the well-known Crépon, Duguet, and Mairesse (or CDM) model (Crépon et al., 1998), to capture the linkages between R&D, innovation, and productivity. Consistent with prior evidence on the existence of industry specific patterns, the results mainly suggest that the ICT sector indeed features distinctive innovation complementarities, and that ICT firms' innovation strategies tend to be more complex than they are in other, less R&D-intensive sectors. Not accounting for such specificities may lead to an underestimation of the impact of innovation on productivity in the ICT sector. Indeed, innovation strategies in this R&D-intensive sector are multidimensional and translate into complex innovation modes, which in turn influence the performance of firms. The results are in line with earlier studies bringing evidence of the complex links between innovation and productivity (see Hall, 2011 for a review). Accordingly, the paper calls for enhanced measurements of innovations and their complementarities for a better representation of the innovation-productivity relationship. Such exercises, including benchmarking with other high-intensive R&D manufacturing or service sectors, would allow better fitted IRI policy for ICT industries with a dual aim: *(i)* boosting innovation in the ICT industries; and *(ii)* boosting innovation indirectly in the rest of the economy, reflecting the general purpose nature of ICTs.

IV. Concluding remarks

Innovation policy has the aim of influencing innovation activity with the overall goal of increasing economic growth and, with it, competitiveness and job creation. It also embraces the so-called 'mission-oriented' objectives which aim at addressing more specific societal concerns (e.g. environmental pollution, social exclusion, health and welfare, energy shortages). However, the complexity and speed of recent innovation and socio-economic developments make it difficult for policy-makers to take the optimum decisions. This is particularly true when addressing unpredictable and intangible items such as corporate research and innovation in a globalised economy.

Over the last few decades, policy decision-making approaches have increased the demand for better integration of more rigorous evidence-based practices for the formulation and implementation of government policies. In other words, as Fagerberg (2017) put it, we are seeing the development of a new, systemic understanding of innovation (both innovation

activity and policy) that is much more appropriate than before when it merely attempted to account for certain 'stylised facts' as identified by empirical work. This introductory article has investigated the extent to which the available evidence satisfactorily supports policy actions for corporate R&D and innovation. It relies on recent studies that offer the prospect of relevant conceptual and empirical insights supporting a better informed R&D and innovation policy.

A number of possible links between the key challenges for innovation studies and examples of the broad implications for policies supporting industrial research and innovation have been identified. For instance, innovation studies are often biased towards dominant forms of innovation (e.g. manufacturing, high-tech sectors), while it is now more widely recognized that innovation and its processes exhibit important sector specificities (e.g. conditions for knowledge accumulation, appropriability and diffusion). From a policy perspective, these particular features raise fundamental questions related to the type of innovation (impact) that is desired and thus should be supported by the policy intervention. In addition, the (expected) impacts of innovation extend well beyond pure economic outcomes. In policy terms, this means that innovation and its likely direction have to be identified in relation to the final expected outcome(s), which is not innovation in itself but, for instance, growth, productivity, inequality reduction, environmental sustainability or social inclusiveness.

Furthermore, a set of critical issues related to evidence-based practices which translate into innovation policy-thinking and policy-making have been identified. These relate to the limitations of existing theoretical/conceptual frameworks, the misuse of available evidence, and the extent to which the scientific community is able (with suitable data and methodological approaches) to respond to policy needs in a timely manner.

In addition, there are a number of questions regarding evidence-informed policy that deserve further research and policy debate, for instance: (a) How can one better coordinate territorial policy frameworks and tools to avoid duplication or crowding out in policy making and implementation? (b) How can evaluations be used to ensure that effective policy learning takes place? (c) How can one best integrate other socio-economic dimensions that matter for innovation performance (e.g. attitudes toward risk, product market and labour market regulations, etc.) in innovation policy-making? (d) How is the hierarchy of evidence and methodologies accounted for in the design of policies and policy interventions? (e) How can one improve the science-policy dialogue to limit the use of evidence based on just a single study, given the often contextual and contestable nature of the scientific findings? (f) Is there room for policy experimentation before the introduction of measures tailored to corporate R&D and innovation on a larger scale?

Although we would agree that innovation policy studies may be acquiring at least some of the characteristics of a 'discipline' (Martin, 2012), we argue that international practitioners need to adopt a genuinely systemic approach to innovation policies. This might be supported through the establishment of a forum of international practitioners in order to share best methodological, empirical and policy practices in the area of industrial innovation and entrepreneurship economics, as well as to discuss and identify common challenges for the

future. This would also help to reduce the gap that currently exists between academic and policy circles and perspectives.

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